United States Patent Office

3,546,034
Patented Dec. 8, 1970

3,546,034

AMMONIUM NITRATE-NITROMETHANE TYPE BLASTING AGENT CONTAINING UREA AS A CRYSTALLIZATION INHIBITOR

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No Drawing. Filed June 19, 1968, Ser. No. 738,100
Int. Cl. C06b 1/04
U.S. Cl. 149—47 2 Claims

ABSTRACT OF THE DISCLOSURE

Crystallization-resistant blasting slurries of the ammonium nitrate-nitromethane type having a urea as the crystallization inhibitor.

BACKGROUND OF THE INVENTION

This invention relates to slurry type blasting agent compositions. In a particular aspect, it relates to blasting agent compositions resistant to low temperature crystallization.

Aqueous blasting slurry compositions consisting primarily of inorganic nitrate, a sensitizer and gelling agent, plus various additives in small amount are well known in the explosives industry. They have a high density and good cohesive properties and can be charged into wet bore holes without undue risk of dilution. Slurries using 3–40% of a nitroparaffin as the sensitizer are disclosed in U.S. Pat. 3,356,544.

Blasting slurries of this general type have been used in large volume but they have suffered from the disadvantage that, when formulated in the lower water concentrations, the ammonium nitrate tends to crystallize in cold weather. As a result segregation and low sensitivity may occur, the slurry may not fill the hole properly and may even set up to a hard mass. Since blasting operations can otherwise be conducted at relatively low temperatures, it is desirable to employ a slurry which is formulated with a minimum of water, yet resists crystallization.

This problem with respect to ammonium nitrate slurries formulated with coarse TNT grains as the sensitizer was resolved by Cook, U.S. Pat. 2,930,685, by using either sodium nitrate or urea in an amount of 1–25% to lower the melting point of the slurry.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a slurry-type blasting agent composition.

It is another object to provide an ammonium nitrate-nitromethane blasting agent composition resistant to crystallization at low temperatures.

Other objects of this invention will be obvious to those skilled in the art.

It has now been discovered that, by incorporating urea into slurry-type blasting agents formulated with ammonium nitrate, nitromethane as the sensitizer, a gelling agent, and water, compositions are obtained which are resistant to crystallization at below-freezing temperatures. These compositions do not set up to a solid mass, nor segregate nor undergo phase separation under most of the climatic conditions encountered during blasting operations.

DETAILED DESCRIPTION

The present invention provides a method of inhibiting crystallization of ammonium nitrate-nitromethane slurry-type blasting agents to temperatures as low as about 12–14° F.

Urea is added in a proportion of about 4–7% by weight of the slurry, and is sufficient to inhibit crystallization at low temperatures. For example the use of 5% urea and 20% nitromethane permit ammonium nitrate concentrations of up to 66% by weight with only 5% water. Microballoons are added to the formulation to sensitize the nitromethane. The nitromethane can be used in a proportion of 20% to 30% by weight of the slurry. When preferred, up to one half of the nitromethane can be replaced with tris-(hydroxymethyl)nitromethane.

The ammonium nitrate suitable for use in the practice of this invention can be any grade which is generally useful in blasting agent slurries. This includes the ordinary commercial grade. Preferably the ammonium nitrate is uncoated, i.e. it is free from the coating generally applied to fertilizer grade material to reduce its hygroscopicity.

The urea suitable for the practice of this invention can be any grade of commerce, and generally the lowest in cost is preferred. The grade used in fertilizer compositions is a preferred grade. Generally, the urea is present to the extent of from about 1% to about 7% by weight, preferably 4% to 6%, based on the weight of the total composition.

The nitromethane and tris(hydroxymethyl)nitro-methane (TN) useful as sensitizers in the practice of this invention are common articles of commerce and the ordinary commercial grades are suitable. TN is available as a 50% aqueous solution, and this form is perferred. The water content of the slurry is adjusted accordingly.

The gelling agent used may be any of those materials, or a mixture thereof, which are capable of setting up the aqueous mixture in a gel-like consistency or in the form of a relatively thick cohesive paste as is known in the art. The gelling agent can be one of the well-known gums such as guar, okra, or locust bean, or it can be any of the synthetics known to the art. It may be supplemented with other gelling agents or thickeners such as wood flour, cellulose ester gum and the like. Preferably, a mixture of two or more gelling agents or thickeners is used in an amount sufficient to impart the desired consistency to the slurry. The preferred consistency maintains all components, including solid materials, uniformly distributed in the slurry over an extended period of time.

The final consistency is preferably one which gives a cohesive, but pourable, mass. The effectiveness of the gelling agent varies greatly and it is within the skill of one familiar with their performance characteristics to use an appropriate amount consistent with the amount of water incorporated in the wet blasting agent.

In addition to the principal constituents listed above, other additives such as aluminum flakes or powder, microballoons, or zinc oxide can be incorporated as is known in the art.

Most of the compositions of the invention are insensitive to detonating action of a No. 8 commercial blasting cap, but are detonatable by conventional "booster" charges of PETN (pentaerythritol tetranitrate), RDX (cyclotrimethylenetrinitramine), Pentolite (PETN-TNT, 50/50), tetryl, Composition B (RDX–TNT 60/40), gelatin dynamites and the like.

The practice of this invention is further illustrated by the following examples.

In these examples, velocity was determined using schedule 40 steel pipe of the size shown.

Sensitivity to initiation was tested by detonating C–4 military explosive (consisting of RDX 91%, plasticizer 5.3%, polyisobutylene 2.1%, and motor oil 1.6%) in contact with the slurry in increasing 1 g. increments until detonation of the slurry occurred.

The texture and crystallization resistance were de-

termined by storing samples of the slurries at 14° F. and judging their consistency.

Examples 1–5

Blasting slurries employing ammonium nitrate and nitromethane as the sensitizer with #2 nitrocellulose as a gelling agent for the nitromethane and microballoons as supplementary sensitizers for the nitromethane were formulated with 5% urea and 10% water. No. 2 nitrocellulose is a fast gelling grade of nitrocellulose meeting U.S. military specification JAN–N–244, Grade 1, type 1. The gelling agent used was guar gum, EXFC 50–H manufactured by Stein Hall Co. The urea made possible very high ammonium nitrate concentration. The slurries exhibited good crystallization resistance and had satisfactory sensitivities and velocities. The compositions are as follows:

	Example No.				
	1	2	3	4	5
Ingredients, percent wt.:					
Urea	5.0	5.0	5.0	5.0	5.0
Ammonium nitrate	50.5	55.3	61.0	61.0	66.0
Water	10.0	10.0	10.0	10.0	5.0
Gelling agent	0.5	0.5	0.5	0.5	0.5
Microballons	2.0	2.0	22.0	2.0	2.0
Nitromethane	30.0	25.0	20.0	20.0	20.0
No. 2 nitrocellulose	2.0	1.7	1.5	1.5	1.5
Sensitivity to C–4, g	10	[1] 30	35	15	15
Velocity, ft./sec., 3"	19,250	16,200	16,450	18,000	15,450
Velocity, ft./sec., 2"	15,300	14,600	-------	19,500	-------

[1] Tetryl.

What is claimed is:

1. A method of inhibiting crystallization of a slurry-type blasting agent at low temperatures said blasting agent consisting essentially of ammonium nitrate, sensitized nitromethane, water, and gelling agent, consisting of incorporating in said slurry, urea in a proportion of about 4 to 7% by weight of the slurry.

2. The method of claim 1 wherein the urea is incorporated in a proportion of about 5% by weight.

References Cited

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U.S. Cl. X.R.

149—2, 60, 89

PO-1050
(5/69)

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. U.S. 3,546,034 Dated December 8, 1970

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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 10, "tris-(hydroxymethyl)" should be --tris(hydroxymethyl)--; line 25, "nitro-methane" should be --nitromethane--; line 29, "perferred" should be --preferred--.

Signed and sealed this 29th day of June 1971.

(SEAL)
Attest:

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